

What is claimed is:

1. A method for operating a cardiac rhythm management device in a patient, comprising:

5 delivering paces to both right and left ventricles in accordance with a programmed biventricular pacing mode, such that the paces are delivered at a programmed biventricular offset interval and after a programmed AV delay interval with respect to an atrial event;

switching to LV-only pacing mode and recording an evoked response test  
10 electrogram during an LV-only pace with the programmed AV delay interval;

comparing the test electrogram to an evoked response template electrogram previously recorded during LV-only pacing when the programmed AV delay interval was known to be matched to the patient's then existing intrinsic AV interval;

adjusting the programmed AV delay interval to match the patient's current  
15 intrinsic AV interval based upon the comparison of the test and template electrograms;  
returning to the biventricular pacing mode with the adjusted AV delay interval.

2. The method of claim 1 wherein the test electrogram is recorded from a right ventricular sensing channel.

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3. The method of claim 2 wherein the comparing of the test and template electrograms further comprises:

determining when peaks in the test and template electrograms occur relative to the pace;

25 shortening the programmed AV delay interval if the peak in the test electrogram occurs earlier than the peak in the template; and,

lengthening the programmed AV delay interval if the peak in the test electrogram occurs later than the peak in the template.

4. The method of claim 1 further comprising determining matched programmed AV delay intervals at a plurality of different pacing rates.

5. The method of claim 4 further comprising:

5 using the matched AV delay intervals as determined at the plurality of pacing rates may to form a mapping function which maps particular pacing rates to particular programmed AV delay intervals; and,

automatically adjusting the programmed AV delay interval according to the mapping function as the pacing rate changes.

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6. The method of claim 5 wherein the mapping function is a look-up table.

7. The method of claim 5 wherein the mapping function is a linear function.

15 8. A method for operating a cardiac rhythm management device in a patient, comprising:

delivering paces to both right and left ventricles in accordance with a programmed biventricular pacing mode, such that the paces are delivered at a programmed biventricular offset interval and after a programmed AV delay interval  
20 with respect to an atrial event;

upon a change by a specified amount in a current pacing rate at which the right and left ventricular paces are delivered, adjusting the programmed AV delay interval according to a mapping function which maps a particular pacing rate to a particular AV delay interval;

25 switching to LV-only pacing mode and recording an evoked response test electrogram during an LV-only pace with the programmed AV delay interval;

comparing the test electrogram to an evoked response template electrogram previously recorded during LV-only pacing when the programmed AV delay interval was known to be matched to the patient's then existing intrinsic AV interval;

if the test and template electrograms do not sufficiently correlate, adjusting the mapping function so that the programmed AV delay interval which is mapped to by the current pacing rate matches the patient's current intrinsic AV interval based upon the comparison of the test and template electrograms; and

5           returning to the biventricular pacing mode with the adjusted mapping function.

9.       The method of claim 8 wherein the test electrogram is recorded from a right ventricular sensing channel and the comparing of the test and template electrograms further comprises:

10           determining when peaks in the test and template electrograms occur relative to the pace;

          shortening the mapped to AV delay interval if the peak in the test electrogram occurs earlier than the peak in the template; and,

          lengthening the mapped to AV delay interval if the peak in the test electrogram  
15       occurs later than the peak in the template.

10.      The method of claim 8 further comprising recording the test electrogram and comparing the test electrogram with the template electrogram only at periodic intervals.

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11.      A cardiac rhythm management device, comprising:

          pacing channels through which paces may be delivered to both right and left ventricles;

          a controller programmed to deliver the paces in accordance with a programmed  
25       biventricular pacing mode at a programmed biventricular offset interval and after a programmed AV delay interval with respect to an atrial event;

          wherein the controller is programmed to:

          switch to an LV-only pacing mode and record an evoked response test electrogram during an LV-only pace;

compare the test electrogram to an evoked response template electrogram previously recorded during LV-only pacing when the programmed AV delay interval was known to be matched to the patient's then existing intrinsic AV interval;

adjust the programmed AV delay interval to match the patient's current  
5 intrinsic AV interval based upon the comparison of the test and template electrograms;  
and,

return to the biventricular pacing mode with the adjusted AV delay interval.

12. The device of claim 11 wherein the test electrogram is recorded from a right  
10 ventricular sensing channel.

13. The device of claim 12 wherein the controller is programmed to compare the test and template electrograms by:

determining when peaks in the test and template electrograms occur relative to  
15 the pace;

shortening the programmed AV delay interval if the peak in the test electrogram occurs earlier than the peak in the template; and,

lengthening the programmed AV delay interval if the peak in the test electrogram occurs later than the peak in the template.

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14. The device of claim 11 wherein the controller is programmed to determine matched programmed AV delay intervals at a plurality of different pacing rates.

15. The device of claim 14 wherein the controller is programmed to:

25 use the matched AV delay intervals as determined at the plurality of pacing rates may to form a mapping function which maps particular pacing rates to particular programmed AV delay intervals; and,

automatically adjust the programmed AV delay interval according to the mapping function as the pacing rate changes.

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16. The device of claim 15 wherein the mapping function is a look-up table.

17. The device of claim 15 wherein the mapping function is a linear function.

5 18. A cardiac rhythm management device, comprising:

pacing channels through which paces may be delivered to both right and left ventricles;

a controller programmed to deliver the paces in accordance with a programmed biventricular pacing mode at a programmed biventricular offset interval and after a  
10 programmed AV delay interval with respect to an atrial event;

wherein the controller is programmed to:

upon a change by a specified amount in a current pacing rate at which the right and left ventricular paces are delivered, adjust the AV delay interval according to a mapping function which maps a particular pacing rate to a particular AV delay  
15 interval;

switch to LV-only pacing mode and recording an evoked response test electrogram during an LV-only pace;

compare the test electrogram to an evoked response template electrogram previously recorded during LV-only pacing when the programmed AV delay interval  
20 was known to be matched to the patient's then existing intrinsic AV interval;

if the test and template electrograms do not sufficiently correlate, adjust the mapping function so that the programmed AV delay interval which is mapped to by the current pacing rate matches the patient's current intrinsic AV interval based upon the comparison of the test and template electrograms; and

25 return to the biventricular pacing mode with the adjusted mapping function.

19. The device of claim 18 wherein the test electrogram is recorded from a right ventricular sensing channel and the controller is programmed to compare the test and template electrograms and adjust the mapping function by:

determining when peaks in the test and template electrograms occur relative to the pace;

shortening the mapped to AV delay interval if the peak in the test electrogram occurs earlier than the peak in the template; and,

5           lengthening the mapped to AV delay interval if the peak in the test electrogram occurs later than the peak in the template.

20.    The device of claim 18 wherein the controller is programmed to record the test electrogram and comparing the test electrogram with the template electrogram only at  
10   periodic intervals.

21.    A method for setting pacing parameters of a cardiac rhythm management device implanted in a patient, comprising:

          setting a pacing parameter to a plurality of different values while assessing the  
15   patient's hemodynamic performance in order to determine an optimum value which results in the best hemodynamic performance;

          setting the pacing parameter to the optimum value, recording an evoked response electrogram during delivery of a pace, and storing the recorded electrogram as a template;

20       recording test evoked response electrograms during one or more cardiac cycles and comparing the morphologies of the test electrogram and the template; and,

          adjusting the value of the pacing parameter so that the morphology of a subsequently recorded test electrogram will more nearly resemble the morphology of the template.

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